PATENT ABSTRACTS OF JAPAN

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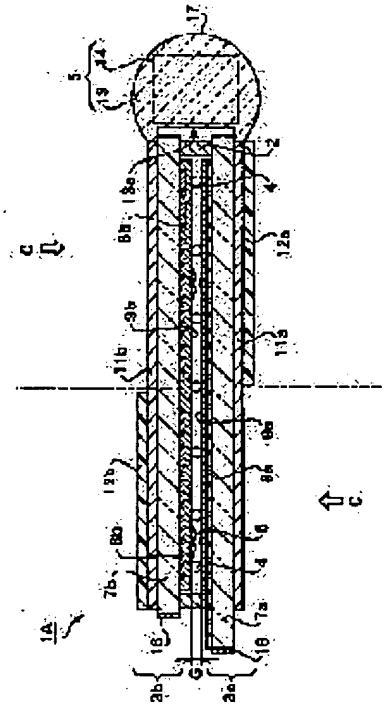
(54) LIQUID CRYSTAL DEVICE AND ELECTRONIC APPARATUS

(57)Abstract:

PROBLEM TO BE SOLVED: To make it possible to embody a display form of a transmission type using an illumination device 5 of a liquid crystal device of a both surface display type.

SOLUTION: This liquid crystal device of the both surface display type is the liquid crystal device having a pair of substrates 3a and 3b facing each other across liquid crystals 6 and displays images from both sides of a pair of these substrates 3a and 3b. Part or the whole of the flanks of a pair of the substrates 3a and 3b is provided with the illumination device 5 for irradiating the same with light. The light from the illumination device 5 propagates in the substrates 3a and 3b and flatly spreads. The images are displayed on both front and rear surfaces of the liquid crystal panel 1A by utilizing the light.



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CLAIMS

[Claim(s)]
[Claim 1] Liquid crystal equipment characterized by forming a lighting means to irradiate light in the side face of the substrate of said pair in the liquid crystal equipment of the double-sided means of displaying which has the substrate of the pair which counters mutually on both sides of liquid crystal, and displays by both sides of the substrate of these pairs.
[Claim 2] It is liquid crystal equipment characterized by having the light guide section material which leads the light from the light source to which said lighting means emits light in claim 1, and its light source to the side face of the substrate of said pair.
[Claim 3] Liquid crystal equipment characterized by preparing a light reflex layer in the opposite side of the field where light is introduced among the side faces of the substrate of said pair in claim 1 or claim 2.
[Claim 4] It is liquid crystal equipment characterized by said lighting means irradiating light in claim 1 or claim 2 at the perimeter of the side face of the substrate of said pair.
[Claim 5] It is electronic equipment by which said liquid crystal equipment is characterized by the thing of claim 1 to claim 4 constituted [any / one] by the liquid crystal equipment of a publication at least in the electronic equipment which has liquid crystal equipment and the case which holds the liquid crystal equipment.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal equipment which displays images, such as an alphabetic character, a figure, and a pattern, by controlling the orientation of the liquid crystal closed between the substrates of a pair. Moreover, this invention relates to the electronic equipment constituted using the liquid crystal equipment.
[0002]
[Description of the Prior Art] In electronic equipment, such as current, a portable telephone, and a Personal Digital Assistant machine, liquid crystal equipment is used widely. In order to display information, such as an alphabetic character, a figure, and a pattern, in many cases, the liquid crystal equipment is used.
[0003] Generally this liquid crystal equipment has the liquid crystal pinched by the substrate of a pair, and controls the orientation of that liquid crystal by controlling the electrical potential difference impressed to that liquid crystal. By this orientation control, it displays on liquid crystal by modulating the light which carries out incidence. In many cases, a light reflex layer and a back light are arranged in one rear face of the substrates of a pair, and an image is expressed on the front face of the substrate which counters it as this liquid crystal equipment. That is, in many cases, it is one side means of displaying.
[0004] Moreover, as conventional liquid crystal equipment, as shown in JP,10-198291,A, the liquid crystal equipment of the so-called double-sided means of displaying of the method which displays in front flesh-side both sides of a liquid crystal panel is also known.
[0005]
[Problem(s) to be Solved by the Invention] About the liquid crystal equipment of the above-mentioned double-sided means of displaying, on the relation in which a display is performed using front flesh-side both sides of a liquid crystal panel, the operation as a reflective mold using an extraneous light which it is difficult to arrange a lighting system and is called sunlight etc. can only be considered, and the operation of the transparency mold using a lighting system was not considered.
[0006] This invention is accomplished in view of the above-mentioned trouble, and aims at realizing the display gestalt using a lighting system in the liquid crystal equipment of double-sided means of displaying.
[0007]
[Means for Solving the Problem] (1) In order to attain the above-mentioned purpose, the liquid crystal equipment concerning this invention is liquid crystal equipment which has the substrate of the pair which counters mutually on both sides of liquid crystal, and is characterized by forming a lighting means to irradiate light in the side face of the substrate of said pair in the liquid crystal equipment of the double-sided means of displaying which displays by both sides of the substrate of these pairs.
[0008] In this liquid crystal equipment, a display is performed by the light irradiated by the side face of a substrate spreading the interior of a substrate, and modulating breadth and this light with liquid crystal superficially. And thereby, the liquid crystal equipment of a double-sided transparency mold is realized.
[0009] (2) In the liquid crystal equipment of the above-mentioned configuration, a lighting means can be constituted so that the light which carried out incidence from the end face can be irradiated in the shape of Rhine by light guide section material etc. More specifically, the light source which emits light, and the light guide section material which

leads the light from the light source to the side face of the substrate of said pair can constitute a lighting means. By using this light guide section material, a uniform light can be supplied to a liquid crystal panel. Moreover, a cold cathode tube, the thing constituted so that LED might be arranged in the shape of Rhine and light could be emitted in the shape of a field can also be used as a lighting means.

[0010] About each above lighting means, the thickness of the end face of a liquid crystal panel, and width of face and the dimension of the outgoing radiation part of light are all the same, or it is desirable to constitute so that it may become less than [it]. Moreover, when the optical outgoing radiation dimension by the side of a lighting means is larger, it is desirable to extract the outgoing radiation light with a slit or a lens.

[0011] If the dimension of the outgoing radiation light of a lighting means is regulated as mentioned above, light will not leak except a glass end face, the use effectiveness of light will increase, and the effectiveness that the fault by the stray light does not arise will be acquired.

[0012] (3) In the liquid crystal equipment of the above-mentioned configuration, a light reflex layer can be prepared in the opposite side of the field where light is introduced among the substrates of a pair. If it carries out like this, it can prevent emanating to the exterior unnecessarily, without the light which spreads the interior of a substrate contributing to a display.

[0013] (4) About the liquid crystal equipment of the above-mentioned configuration, light can be irradiated with a lighting means at the perimeter of the side face of the substrate of a pair. If it carries out like this, a very bright display can be performed in the liquid crystal equipment of double-sided means of displaying.

[0014] (5) Next, in the electronic equipment by which the electronic equipment concerning this invention has liquid crystal equipment and the case which holds the liquid crystal equipment, said liquid crystal equipment is characterized by being constituted by the liquid crystal equipment indicated in each item of (1) to (4). As such electronic equipment, a portable telephone, a Personal Digital Assistant machine, etc. can be considered, for example.

[0015]

[Embodiment of the Invention] (The 1st operation gestalt) Drawing 1 shows 1 operation gestalt of the liquid crystal equipment concerning this invention. This liquid crystal equipment is constituted by attaching a lighting system 5 and IC for a liquid crystal drive (not shown) to liquid crystal panel 1A. Liquid crystal panel 1A of this operation gestalt is taken as the liquid crystal panel of the passive matrix which does not use an active component.

[0016] This liquid crystal panel 1A has the substrate of a pair to which the circumference was joined by the sealant 2, i.e., common substrate 3a, and segment substrate 3b. Spacing of these substrates and the so-called cel gap G are maintained by fixed magnitude with a spacer 4, and the closure of the liquid crystal 6 is carried out into the cel gap.

[0017] Common substrate 3a has transparent ingredient substrate 7a, patterning of the common electrode 8a is carried out to a predetermined configuration on the inside front face of the ingredient substrate 7a, and orientation film 9a is further formed on it. moreover -- the outside front face of ingredient substrate 7a -- the front face -- polarizing plate 11a sticks on the whole region mostly -- having -- further -- a part of front face of the ingredient substrate 7a -- 1st reflecting layer 12a is prepared in a field.

[0018] Segment substrate 3b which counters common substrate 3a has transparent ingredient substrate 7b. In the inside front face of this ingredient substrate 7b, patterning of the segment electrode 8b is carried out to a predetermined configuration, and orientation film 9b is further formed on it. moreover -- the outside front face of ingredient substrate 7b -- the front face -- polarizing plate 11b sticks on the whole region mostly -- having -- further -- a part of front face of the ingredient substrate 7b -- 2nd reflecting layer 12b is prepared in a field. This 2nd reflecting layer 12b is prepared corresponding to the field in which 1st reflecting layer 12a by the side of common substrate 3a is not prepared. That is, it is prepared by the relation which regards as 1st reflecting layer 12a and 2nd reflecting layer 12b superficially, and complements a location mutually.

[0019] A lighting system 5 is arranged in the side face of liquid crystal panel 1A. This lighting system 5 is formed of the light guide section material 13 prepared corresponding to one of four sides of liquid crystal panel 1A, and the light source 14 prepared in the edge of that light guide section material 13, as shown in drawing 2 . The light guide section material 13 has the structure which carries out outgoing radiation of the light incorporated from the end to the shape of Rhine, and the light which carries out outgoing radiation to the shape of the Rhine is irradiated by the side face of the ingredient substrates 7a and 7b of a pair. In drawing 1 , such structure forms the proper concavo-convex pattern for leading light to a longitudinal direction in partial 13a corresponding to the side face of liquid crystal panel 1A, and can attain it by forming a reflecting layer 17 in the other surface field. In addition, in order to prevent that the light from a

lighting system 5 diffuses to the exterior unnecessarily, it is desirable to form the light reflex layer 16 in the edge of the opposite side of each ingredient substrates 7a and 7b.

[0020] In addition, if a lighting system 5 can also be arranged over the perimeter of not only one side of liquid crystal panel 1A but its side face and it carries out like this, it can illuminate the whole surface of liquid crystal panel 1A to homogeneity.

[0021] In the above configuration, the ingredient substrates 7a and 7b are formed with transparent ingredients, such as glass and plastics. Moreover, common electrode 8a and segment electrode 8b are formed of ITO (Indium Tin Oxide: indium stannic-acid ghost). Moreover, the orientation film 9a and 9b is formed with polyimide etc. Moreover, polarizing plates 11a and 11b are polarization separative elements which have the function in which make the linearly polarized light which turns to a certain one direction penetrate as everyone knows, and the other polarization is not made to penetrate by absorption etc.

[0022] Since 1st reflecting layer 12a and 2nd reflecting layer 12b are formed of a non-transparent material, in liquid crystal panel 1A of this operation gestalt, the transverse-plane side of each reflecting layers 12a and 12b is an observation side, and an observer observes liquid crystal panel 1A from front flesh-side both sides shown by the arrow head C, and checks an image. That is, an image can be expressed on one front flesh-side both sides of liquid crystal panel 1A as this operation gestalt.

[0023] Considering the case where it displays as a liquid crystal panel of a reflective mold now using an extraneous light called sunlight etc., as shown in drawing 3 , an image is displayed on the front flesh-side both sides of liquid crystal panel 1A by the contrast between the light reflected by 1st reflecting layer 12a and 2nd reflecting layer 12b, and the light absorbed with polarizing plates 11a and 11b.

[0024] Moreover, in the dark place which cannot use an extraneous light, an image is displayed on the front flesh-side both sides of liquid crystal panel 1A by the light which carries out outgoing radiation from a lighting system 5, and is drawn in the direction of a flat surface by each ingredient substrates 7a and 7b.

[0025] (The 2nd operation gestalt) Drawing 4 shows other operation gestalten of the liquid crystal equipment concerning this invention. In this drawing, the same thing as the member shown in drawing 1 will attach and show the same sign, and the explanation about them is omitted. The point that liquid crystal panel 1B concerning this operation gestalt differs from liquid crystal panel 1A shown in drawing 1 Throughout the outside front face of material substrate 7b which constitutes the whole region on the front face of an outside of material substrate 7a and segment substrate 3b which constitute common substrate 3a It is having stuck polarizing plates 22a and 22b throughout the outside front face of forming the reflective polarizers 21a and 21b and those reflective polarizers 21a and 21b, respectively.

[0026] It will be as follows if these reflective polarizers 21a and 21b are explained. To doing so the function of not making the other polarization penetrate by absorption, distribution, etc., while making the linearly polarized light a common polarizing plate turns [linearly polarized light] to a certain one direction penetrate, these reflective polarizers 21a and 21b reflect the other linearly polarized light while making the linearly polarized light of a certain one direction penetrate, and the linearly polarized light of the direction of a right angle does so especially the function carry out total reflection, to a transparency polarization shaft.

[0027] As indicated by the international application (the international application number WO 95/17692 or WO 95/27919) by which ** international public presentation was carried out, such a reflective polarizer The polarization separation film of the structure which carried out several multi-sheet laminating of the thin film, and the polarization division plate of the structure which arranged lambda (1/4) plate in the both sides or one side of ** cholesteric-liquid-crystal layer, ** the polarization separation member (from the 427th page to the 429th page [SID 92DIGEST]) of the structure divided into reflective polarization and transparency polarization using Brewster's include angle -- or it can constitute using the polarization separation member using ** hologram etc.

[0028] As shown in drawing 5 , these reflective polarizers 21a and 21b have two or more layer structure formed by carrying out the laminating of two kinds of layers A and B by turns, and set it among two-layer [those / that adjoins each other in the direction of a laminating mutually among A and B two or more layers]. The refractive index of a certain one direction is between two-layer [these], and is equal, and the refractive index of it and the direction of a right angle is set up so that it may differ among two-layer [these], and it is giving change to the thickness of the layer of further each.

[0029] In drawing 5 , when considering rectangular cross 3 shaft orientations of XYZ, two-layer [of A and B] is formed in a multilayer condition, further, is extended by extrusion molding along an one direction (for example, the

direction of X), and is not extended by other one directions (namely, the direction of Y) by it. That is, X shaft orientations are the extension directions and Y shaft orientations are longitudinal directions to it. B ingredient has a refractive index nS (for example, nS=1.64), and this does not change with extension processings substantially. On the other hand, A ingredient has the property that a refractive index changes with extension processings. For example, when extension processing of the sheet which consists of A ingredient is carried out at 1 shaft orientations, it has one refractive index nAX (for example, nAX=1.88) in the extension direction (namely, the direction of X), and comes to have a different refractive index nAY (for example, nAY=1.64) in a longitudinal direction (namely, the direction of Y).

[0030] If the laminated structure of drawing 5 which consists of A and B ingredient is extended in the direction of X, refractive-index difference deltan=1.88-1.64=0.24 [big] will occur about the extension direction. About as right-angled on the other hand the direction of Y as it, it is refractive-index difference deltan=1.64-1.64=0 between A and B each class, and a difference is not produced in a refractive index. If light carries out incidence to this reflective polarizer for such an optical property, the polarization component (a) of the direction of transparency shaft E will penetrate this reflective polarizer among that incident light. On the other hand, the polarization component (b) of the direction of extinction shaft F of the incident light will face refractive-index difference deltan, and, so, is reflected in the part.
[0031] Furthermore, the thickness t1, t2, and t3 between A and B each class, -- -- -- The light (b-1) from which change was added little by little to the dimension, and wavelength so differed in the interface of each class as shown in drawing 6 , (b-2), -- -- -- It can reflect now. That is, it becomes possible to reflect the light containing all kinds of wavelength efficiently according to the multilayer structure of A which changed thickness, and B-2 class.
[0032] By the way, the thickness t1, t2, and t3 of each class, -- -- -- If combined with thickness which reflects the light of all wavelength, the reflected light finally obtained will turn into the white light. On the other hand, they are the thickness t1, t2, and t3 of each class, and --. -- -- If it is set as a suitable combination, only the light of the wavelength of hope, i.e., the color of hope, can be alternatively reflected with a reflective polarizer.
[0033] In this operation gestalt, as shown in drawing 7 , it can cross all over liquid crystal panel 1B, and an image can be displayed by front flesh-side both sides over the whole surface of liquid crystal panel 1B by the contrast between the light reflected with the reflective polarizers 21a and 21b, and the light which penetrates liquid crystal panel 1B. Moreover, in the dark place which cannot use an extraneous light, an image is displayed on front flesh-side both sides of liquid crystal panel 1B by the light which carries out outgoing radiation from a lighting system 5, and is drawn in the direction of a flat surface by each ingredient substrates 7a and 7b.
[0034] (The 3rd operation gestalt) Drawing 8 shows the operation gestalt of further others of the liquid crystal equipment concerning this invention. In this drawing, the same thing as the member shown in drawing 1 will attach and show the same sign, and the explanation about them is omitted.
[0035] Liquid crystal panel 1C concerning this operation gestalt is different in respect of the following compared with liquid crystal panel 1A shown in drawing 1 . namely, a part of inside front face of common substrate 3a -- a field -- aluminum (aluminum) etc. -- inside electrode 23a -- forming -- further -- a part of inside front face of segment substrate 3b -- inside electrode 23b is formed by aluminum etc. as well as a field. The inside electrodes 23a and 23b are formed in the field in which the partner of each other is not prepared, i.e., the relation which sees superficially and complements a location mutually.
[0036] And in the outside front face of segment substrate 3b, inside electrode 23a on other party substrate 3a is countered, and polarizing plate 11b is stuck. Moreover, in the outside front face of common substrate 3a, inside electrode 23b on other party substrate 3b is countered, and polarizing plate 11a is stuck.
[0037] With this operation gestalt, since the inside electrodes 23a and 23b are partially formed about each substrates 3a and 3b, the level difference corresponding to it is formed in the cel gap G. However, it is uniformly maintained over the whole surface of liquid crystal panel 1C in itself [of the cel gap G / magnitude].
[0038] With the operation gestalt shown in drawing 1 , one polarizing plate [two] 11a and 11b exists at a time in front flesh-side both sides of liquid crystal panel 1A in total. On the other hand, with this operation gestalt shown in drawing 8 , one polarizing plate 11b exists to one inside electrode 23a, and one polarizing plate 11a exists to inside electrode 23b of another side. According to this panel structure, only the part which reduced the number of polarizing plates by one sheet about each field can reduce attenuation of the light which passes this panel, and, therefore, can obtain a bright display.
[0039] The transverse-plane side where this operation gestalt counters the inside electrodes 23a and 23b is an

observation side, and an observer can check a display according to an arrow head C from front flesh-side both sides of liquid crystal panel 1C. When using an extraneous light with this operation gestalt, as while it is shown in the right-hand side of drawing shows drawing 9 , front flesh-side one near display is performed by the contrast between the light which reflects by inside electrode 23a in a field, and penetrates polarizing plate 11b, and the light absorbed by the polarizing plate 11b.

[0040] On the other hand, in the field of another side shown in the left-hand side of drawing, the near display of front flesh-side another side is performed by the contrast between the light which reflects by inside electrode 23b and penetrates polarizing plate 11a, and the light absorbed by the polarizing plate 11a.

[0041] Moreover, in the dark place which cannot use an extraneous light, an image is displayed on front flesh-side both sides of liquid crystal panel 1C by the light which carries out outgoing radiation from a lighting system 5, and is drawn in the direction of a flat surface by each ingredient substrates 7a and 7b.

[0042] (The 4th operation gestalt) Drawing 10 shows the Personal Digital Assistant machine which is 1 operation gestalt of the electronic equipment concerning this invention. This Personal Digital Assistant machine 26 has the 1st case 27 and the 2nd case 28. The 2nd case 28 can be opened and closed to the 1st case 27, as shown in drawing 11 and drawing 10 , and liquid crystal equipment 29 is contained inside the 2nd case 28. This liquid crystal equipment 29 can be constituted using liquid crystal panel 1A (drawing 1), liquid crystal panel 1B (drawing 4), or liquid crystal panel 1C (drawing 8).

[0043] As shown in drawing 10 , opening 31, i.e., an aperture, is formed in the front face of the 2nd case 28, and the part by the side of the front face of liquid crystal equipment 29 is exposed to the exterior through the aperture 31. Moreover, as shown in drawing 11 , opening 32, i.e., an aperture, is formed also in the rear face of the 2nd case 28, and the part by the side of the rear face of liquid crystal equipment 29 is exposed to the exterior through the aperture 32. The sign 33 shows the keyboard switch.

[0044] If 7 segment displays are performed to the front-face side of liquid crystal equipment 29 and it is made to perform a dot-matrix display to the rear-face side of liquid crystal equipment now, where the Personal Digital Assistant machine 26 is closed, the display of seven segments can be checked by looking through an aperture 31. Moreover, where the Personal Digital Assistant machine 26 is opened, a dot-matrix display can be checked by looking through an aperture 32.

[0045] (Other operation gestalten) although the desirable operation gestalt was mentioned and this invention was explained above, this invention is not limited to the operation gestalt, within the limits of invention indicated to the claim, is boiled variously and can be changed.

[0046] For example, this invention is not restricted to the liquid crystal panel of a passive matrix, but can be applied also to the liquid crystal panel of the active matrix of structure using nonlinear devices, such as TFT (ThinFilm Transistor) and TFD (Thin Film Diode), as an active component. Moreover, the electronic equipment concerning this invention is not restricted to a Personal Digital Assistant machine, but can be made into the electronic equipment of a portable telephone and other arbitration.

[0047]

[Effect of the Invention] According to the liquid crystal equipment and electronic equipment concerning this invention, when the light irradiated by the side face of a substrate spreads the interior of a substrate and modulates breadth and this light with liquid crystal superficially, it can display. Thereby, the liquid crystal equipment of the double-sided transparency mold of the structure which displays an image on front flesh-side both sides of a liquid crystal panel using the light from a lighting system is realizable.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the liquid crystal equipment which displays images, such as an alphabetic character, a figure, and a pattern, by controlling the orientation of the liquid crystal closed between the substrates of a pair. Moreover, this invention relates to the electronic equipment constituted using the liquid crystal equipment.

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PRIOR ART

[Description of the Prior Art] In electronic equipment, such as current, a portable telephone, and a Personal Digital Assistant machine, liquid crystal equipment is used widely. In order to display information, such as an alphabetic character, a figure, and a pattern, in many cases, the liquid crystal equipment is used.
[0003] Generally this liquid crystal equipment has the liquid crystal pinched by the substrate of a pair, and controls the orientation of that liquid crystal by controlling the electrical potential difference impressed to that liquid crystal. By this orientation control, it displays on liquid crystal by modulating the light which carries out incidence. In many cases, a light reflex layer and a back light are arranged in one rear face of the substrates of a pair, and an image is expressed on the front face of the substrate which counters it as this liquid crystal equipment. That is, in many cases, it is one side means of displaying.
[0004] Moreover, as conventional liquid crystal equipment, as shown in JP,10-198291,A, the liquid crystal equipment of the so-called double-sided means of displaying of the method which displays in front flesh-side both sides of a liquid crystal panel is also known.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to the liquid crystal equipment and electronic equipment concerning this invention, when the light irradiated by the side face of a substrate spreads the interior of a substrate and modulates breadth and this light with liquid crystal superficially, it can display. Thereby, the liquid crystal equipment of the double-sided transparency mold of the structure which displays an image on front flesh-side both sides of a liquid crystal panel using the light from a lighting system is realizable.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] About the liquid crystal equipment of the above-mentioned double-sided means of displaying, on the relation in which a display is performed using front flesh-side both sides of a liquid crystal panel, the operation as a reflective mold using an extraneous light which it is difficult to arrange a lighting system and is called sunlight etc. can only be considered, and the operation of the transparency mold using a lighting system was not considered.
[0006] This invention is accomplished in view of the above-mentioned trouble, and aims at realizing the display gestalt using a lighting system in the liquid crystal equipment of double-sided means of displaying.

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MEANS

[Means for Solving the Problem] (1) In order to attain the above-mentioned purpose, the liquid crystal equipment concerning this invention is liquid crystal equipment which has the substrate of the pair which counters mutually on both sides of liquid crystal, and is characterized by forming a lighting means to irradiate light in the side face of the substrate of said pair in the liquid crystal equipment of the double-sided means of displaying which displays by both sides of the substrate of these pairs.
[0008] In this liquid crystal equipment, a display is performed by the light irradiated by the side face of a substrate spreading the interior of a substrate, and modulating breadth and this light with liquid crystal superficially. And thereby, the liquid crystal equipment of a double-sided transparency mold is realized.
[0009] (2) In the liquid crystal equipment of the above-mentioned configuration, a lighting means can be constituted so that the light which carried out incidence from the end face can be irradiated in the shape of Rhine by light guide section material etc. More specifically, the light source which emits light, and the light guide section material which leads the light from the light source to the side face of the substrate of said pair can constitute a lighting means. By using this light guide section material, a uniform light can be supplied to a liquid crystal panel. Moreover, a cold cathode tube, the thing constituted so that LED might be arranged in the shape of Rhine and light could be emitted in the shape of a field can also be used as a lighting means.
[0010] About each above lighting means, the thickness of the end face of a liquid crystal panel, and width of face and the dimension of the outgoing radiation part of light are all the same, or it is desirable to constitute so that it may become less than [it]. Moreover, when the optical outgoing radiation dimension by the side of a lighting means is larger, it is desirable to extract the outgoing radiation light with a slit or a lens.
[0011] If the dimension of the outgoing radiation light of a lighting means is regulated as mentioned above, light will not leak except a glass end face, the use effectiveness of light will increase, and the effectiveness that the fault by the stray light does not arise will be acquired.
[0012] (3) In the liquid crystal equipment of the above-mentioned configuration, a light reflex layer can be prepared in the opposite side of the field where light is introduced among the substrates of a pair. If it carries out like this, it can prevent emanating to the exterior unnecessarily, without the light which spreads the interior of a substrate contributing to a display.
[0013] (4) About the liquid crystal equipment of the above-mentioned configuration, light can be irradiated with a lighting means at the perimeter of the side face of the substrate of a pair. If it carries out like this, a very bright display can be performed in the liquid crystal equipment of double-sided means of displaying.
[0014] (5) Next, in the electronic equipment by which the electronic equipment concerning this invention has liquid crystal equipment and the case which holds the liquid crystal equipment, said liquid crystal equipment is characterized by being constituted by the liquid crystal equipment indicated in each item of (1) to (4). As such electronic equipment, a portable telephone, a Personal Digital Assistant machine, etc. can be considered, for example.
[0015]
[Embodiment of the Invention] (The 1st operation gestalt) Drawing 1 shows 1 operation gestalt of the liquid crystal equipment concerning this invention. This liquid crystal equipment is constituted by attaching a lighting system 5 and IC for a liquid crystal drive (not shown) to liquid crystal panel 1A. Liquid crystal panel 1A of this operation gestalt is taken as the liquid crystal panel of the passive matrix which does not use an active component.
[0016] This liquid crystal panel 1A has the substrate of a pair to which the circumference was joined by the sealant 2,

i.e., common substrate 3a, and segment substrate 3b. Spacing of these substrates and the so-called cel gap G are maintained by fixed magnitude with a spacer 4, and the closure of the liquid crystal 6 is carried out into the cel gap.
[0017] Common substrate 3a has transparent ingredient substrate 7a, patterning of the common electrode 8a is carried out to a predetermined configuration on the inside front face of the ingredient substrate 7a, and orientation film 9a is further formed on it. moreover -- the outside front face of ingredient substrate 7a -- the front face -- polarizing plate 11a sticks on the whole region mostly -- having -- further -- a part of front face of the ingredient substrate 7a -- 1st reflecting layer 12a is prepared in a field.
[0018] Segment substrate 3b which counters common substrate 3a has transparent ingredient substrate 7b. In the inside front face of this ingredient substrate 7b, patterning of the segment electrode 8b is carried out to a predetermined configuration, and orientation film 9b is further formed on it. moreover -- the outside front face of ingredient substrate 7b -- the front face -- polarizing plate 11b sticks on the whole region mostly -- having -- further -- a part of front face of the ingredient substrate 7b -- 2nd reflecting layer 12b is prepared in a field. This 2nd reflecting layer 12b is prepared corresponding to the field in which 1st reflecting layer 12a by the side of common substrate 3a is not prepared. That is, it is prepared by the relation which regards as 1st reflecting layer 12a and 2nd reflecting layer 12b superficially, and complements a location mutually.
[0019] A lighting system 5 is arranged in the side face of liquid crystal panel 1A. This lighting system 5 is formed of the light guide section material 13 prepared corresponding to one of four sides of liquid crystal panel 1A, and the light source 14 prepared in the edge of that light guide section material 13, as shown in drawing 2 . The light guide section material 13 has the structure which carries out outgoing radiation of the light incorporated from the end to the shape of Rhine, and the light which carries out outgoing radiation to the shape of the Rhine is irradiated by the side face of the ingredient substrates 7a and 7b of a pair. In drawing 1 , such structure forms the proper concavo-convex pattern for leading light to a longitudinal direction in partial 13a corresponding to the side face of liquid crystal panel 1A, and can attain it by forming a reflecting layer 17 in the other surface field. In addition, in order to prevent that the light from a lighting system 5 diffuses to the exterior unnecessarily, it is desirable to form the light reflex layer 16 in the edge of the opposite side of each ingredient substrates 7a and 7b.
[0020] In addition, if a lighting system 5 can also be arranged over the perimeter of not only one side of liquid crystal panel 1A but its side face and it carries out like this, it can illuminate the whole surface of liquid crystal panel 1A to homogeneity.
[0021] In the above configuration, the ingredient substrates 7a and 7b are formed with transparent ingredients, such as glass and plastics. Moreover, common electrode 8a and segment electrode 8b are formed of ITO (Indium Tin Oxide: indium stannic-acid ghost). Moreover, the orientation film 9a and 9b is formed with polyimide etc. Moreover, polarizing plates 11a and 11b are polarization separative elements which have the function in which make the linearly polarized light which turns to a certain one direction penetrate as everyone knows, and the other polarization is not made to penetrate by absorption etc.
[0022] Since 1st reflecting layer 12a and 2nd reflecting layer 12b are formed of a non-transparent material, in liquid crystal panel 1A of this operation gestalt, the transverse-plane side of each reflecting layers 12a and 12b is an observation side, and an observer observes liquid crystal panel 1A from front flesh-side both sides shown by the arrow head C, and checks an image. That is, an image can be expressed on one front flesh-side both sides of liquid crystal panel 1A as this operation gestalt.
[0023] Considering the case where it displays as a liquid crystal panel of a reflective mold now using an extraneous light called sunlight etc., as shown in drawing 3 , an image is displayed on the front flesh-side both sides of liquid crystal panel 1A by the contrast between the light reflected by 1st reflecting layer 12a and 2nd reflecting layer 12b, and the light absorbed with polarizing plates 11a and 11b.
[0024] Moreover, in the dark place which cannot use an extraneous light, an image is displayed on the front flesh-side both sides of liquid crystal panel 1A by the light which carries out outgoing radiation from a lighting system 5, and is drawn in the direction of a flat surface by each ingredient substrates 7a and 7b.
[0025] (The 2nd operation gestalt) Drawing 4 shows other operation gestalten of the liquid crystal equipment concerning this invention. In this drawing, the same thing as the member shown in drawing 1 will attach and show the same sign, and the explanation about them is omitted. The point that liquid crystal panel 1B concerning this operation gestalt differs from liquid crystal panel 1A shown in drawing 1 Throughout the outside front face of material substrate 7b which constitutes the whole region on the front face of an outside of material substrate 7a and segment substrate 3b

which constitute common substrate 3a It is having stuck polarizing plates 22a and 22b throughout the outside front face of forming the reflective polarizers 21a and 21b and those reflective polarizers 21a and 21b, respectively.
[0026] It will be as follows if these reflective polarizers 21a and 21b are explained. To doing so the function of not making the other polarization penetrate by absorption, distribution, etc., while making the linearly polarized light a common polarizing plate turns [linearly polarized light] to a certain one direction penetrate, these reflective polarizers 21a and 21b reflect the other linearly polarized light while making the linearly polarized light of a certain one direction penetrate, and the linearly polarized light of the direction of a right angle does so especially the function carry out total reflection, to a transparency polarization shaft.
[0027] As indicated by the international application (the international application number WO 95/17692 or WO 95/27919) by which ** international public presentation was carried out, such a reflective polarizer The polarization separation film of the structure which carried out several multi-sheet laminating of the thin film, and the polarization division plate of the structure which arranged lambda (1/4) plate in the both sides or one side of ** cholesteric-liquid-crystal layer, ** the polarization separation member (from the 427th page to the 429th page [SID 92 DIGEST]) of the structure divided into reflective polarization and transparency polarization using Brewster's include angle -- or it can constitute using the polarization separation member using ** hologram etc.
[0028] As shown in drawing 5 , these reflective polarizers 21a and 21b have two or more layer structure formed by carrying out the laminating of two kinds of layers A and B by turns, and set it among two-layer [those / that adjoins each other in the direction of a laminating mutually among A and B two or more layers]. The refractive index of a certain one direction is between two-layer [these], and is equal, and the refractive index of it and the direction of a right angle is set up so that it may differ among two-layer [these], and it is giving change to the thickness of the layer of further each.
[0029] In drawing 5 , when considering rectangular cross 3 shaft orientations of XYZ, two-layer [of A and B] is formed in a multilayer condition, further, is extended by extrusion molding along an one direction (for example, the direction of X), and is not extended by other one directions (namely, the direction of Y) by it. That is, X shaft orientations are the extension directions and Y shaft orientations are longitudinal directions to it. B ingredient has a refractive index nS (for example, nS=1.64), and this does not change with extension processings substantially. On the other hand, A ingredient has the property that a refractive index changes with extension processings. For example, when extension processing of the sheet which consists of A ingredient is carried out at 1 shaft orientations, it has one refractive index nAX (for example, nAX=1.88) in the extension direction (namely, the direction of X), and comes to have a different refractive index nAY (for example, nAY=1.64) in a longitudinal direction (namely, the direction of Y).

[0030] If the laminated structure of drawing 5 which consists of A and B ingredient is extended in the direction of X, refractive-index difference deltan=1.88-1.64=0.24 [big] will occur about the extension direction. About as right-angled on the other hand the direction of Y as it, it is refractive-index difference deltan=1.64-1.64=0 between A and B each class, and a difference is not produced in a refractive index. If light carries out incidence to this reflective polarizer for such an optical property, the polarization component (a) of the direction of transparency shaft E will penetrate this reflective polarizer among that incident light. On the other hand, the polarization component (b) of the direction of extinction shaft F of the incident light will face refractive-index difference deltan, and, so, is reflected in the part.
[0031] Furthermore, the thickness t1, t2, and t3 between A and B each class, -- -- -- The light (b-1) from which change was added little by little to the dimension, and wavelength so differed in the interface of each class as shown in drawing 6 , (b-2), -- -- -- It can reflect now. That is, it becomes possible to reflect the light containing all kinds of wavelength efficiently according to the multilayer structure of A which changed thickness, and B-2 class.
[0032] By the way, the thickness t1, t2, and t3 of each class, -- -- -- If combined with thickness which reflects the light of all wavelength, the reflected light finally obtained will turn into the white light. On the other hand, they are the thickness t1, t2, and t3 of each class, and --. -- -- If it is set as a suitable combination, only the light of the wavelength of hope, i.e., the color of hope, can be alternatively reflected with a reflective polarizer.
[0033] In this operation gestalt, as shown in drawing 7 , it can cross all over liquid crystal panel 1B, and an image can be displayed by front flesh-side both sides over the whole surface of liquid crystal panel 1B by the contrast between the light reflected with the reflective polarizers 21a and 21b, and the light which penetrates liquid crystal panel 1B. Moreover, in the dark place which cannot use an extraneous light, an image is displayed on front flesh-side both sides of liquid crystal panel 1B by the light which carries out outgoing radiation from a lighting system 5, and is drawn in the

direction of a flat surface by each ingredient substrates 7a and 7b.
[0034] (The 3rd operation gestalt) Drawing 8 shows the operation gestalt of further others of the liquid crystal equipment concerning this invention. In this drawing, the same thing as the member shown in drawing 1 will attach and show the same sign, and the explanation about them is omitted.
[0035] Liquid crystal panel 1C concerning this operation gestalt is different in respect of the following compared with liquid crystal panel 1A shown in drawing 1 . namely, a part of inside front face of common substrate 3a -- a field -- aluminum (aluminum) etc. -- inside electrode 23a -- forming -- further -- a part of inside front face of segment substrate 3b -- inside electrode 23b is formed by aluminum etc. as well as a field. The inside electrodes 23a and 23b are formed in the field in which the partner of each other is not prepared, i.e., the relation which sees superficially and complements a location mutually.
[0036] And in the outside front face of segment substrate 3b, inside electrode 23a on other party substrate 3a is countered, and polarizing plate 11b is stuck. Moreover, in the outside front face of common substrate 3a, inside electrode 23b on other party substrate 3b is countered, and polarizing plate 11a is stuck.
[0037] With this operation gestalt, since the inside electrodes 23a and 23b are partially formed about each substrates 3a and 3b, the level difference corresponding to it is formed in the cel gap G. However, it is uniformly maintained over the whole surface of liquid crystal panel 1C in itself [of the cel gap G / magnitude].
[0038] With the operation gestalt shown in drawing 1 , one polarizing plate [two] 11a and 11b exists at a time in front flesh-side both sides of liquid crystal panel 1A in total. On the other hand, with this operation gestalt shown in drawing 8 , one polarizing plate 11b exists to one inside electrode 23a, and one polarizing plate 11a exists to inside electrode 23b of another side. According to this panel structure, only the part which reduced the number of polarizing plates by one sheet about each field can reduce attenuation of the light which passes this panel, and, therefore, can obtain a bright display.
[0039] The transverse-plane side where this operation gestalt counters the inside electrodes 23a and 23b is an observation side, and an observer can check a display according to an arrow head C from front flesh-side both sides of liquid crystal panel 1C. When using an extraneous light with this operation gestalt, as while it is shown in the right-hand side of drawing shows drawing 9 , front flesh-side one near display is performed by the contrast between the light which reflects by inside electrode 23a in a field, and penetrates polarizing plate 11b, and the light absorbed by the polarizing plate 11b.
[0040] On the other hand, in the field of another side shown in the left-hand side of drawing, the near display of front flesh-side another side is performed by the contrast between the light which reflects by inside electrode 23b and penetrates polarizing plate 11a, and the light absorbed by the polarizing plate 11a.
[0041] Moreover, in the dark place which cannot use an extraneous light, an image is displayed on front flesh-side both sides of liquid crystal panel 1C by the light which carries out outgoing radiation from a lighting system 5, and is drawn in the direction of a flat surface by each ingredient substrates 7a and 7b.
[0042] (The 4th operation gestalt) Drawing 10 shows the Personal Digital Assistant machine which is 1 operation gestalt of the electronic equipment concerning this invention. This Personal Digital Assistant machine 26 has the 1st case 27 and the 2nd case 28. The 2nd case 28 can be opened and closed to the 1st case 27, as shown in drawing 11 and drawing 10 , and liquid crystal equipment 29 is contained inside the 2nd case 28. This liquid crystal equipment 29 can be constituted using liquid crystal panel 1A (drawing 1), liquid crystal panel 1B (drawing 4), or liquid crystal panel 1C (drawing 8).
[0043] As shown in drawing 10 , opening 31, i.e., an aperture, is formed in the front face of the 2nd case 28, and the part by the side of the front face of liquid crystal equipment 29 is exposed to the exterior through the aperture 31. Moreover, as shown in drawing 11 , opening 32, i.e., an aperture, is formed also in the rear face of the 2nd case 28, and the part by the side of the rear face of liquid crystal equipment 29 is exposed to the exterior through the aperture 32. The sign 33 shows the keyboard switch.
[0044] If 7 segment displays are performed to the front-face side of liquid crystal equipment 29 and it is made to perform a dot-matrix display to the rear-face side of liquid crystal equipment now, where the Personal Digital Assistant machine 26 is closed, the display of seven segments can be checked by looking through an aperture 31. Moreover, where the Personal Digital Assistant machine 26 is opened, a dot-matrix display can be checked by looking through an aperture 32.
[0045] (Other operation gestalten) although the desirable operation gestalt was mentioned and this invention was

explained above, this invention is not limited to the operation gestalt, within the limits of invention indicated to the claim, is boiled variously and can be changed.

[0046] For example, this invention is not restricted to the liquid crystal panel of a passive matrix, but can be applied also to the liquid crystal panel of the active matrix of structure using nonlinear devices, such as TFT (ThinFilm Transistor) and TFD (Thin Film Diode), as an active component. Moreover, the electronic equipment concerning this invention is not restricted to a Personal Digital Assistant machine, but can be made into the electronic equipment of a portable telephone and other arbitration.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the cross-section structure of 1 operation gestalt of the liquid crystal equipment concerning this invention.
[Drawing 2] It is the perspective view showing the appearance of the whole liquid crystal equipment of drawing 1 .
[Drawing 3] It is the sectional view showing typically the display condition about the liquid crystal equipment of drawing 1 .
[Drawing 4] It is the sectional view showing the cross-section structure of other 1 operation gestalten of the liquid crystal equipment concerning this invention.
[Drawing 5] It is the perspective view showing the structure of an example of a reflective polarizer typically.
[Drawing 6] It is drawing for explaining the function of the reflective polarizer of drawing 5 .
[Drawing 7] It is the sectional view showing typically the display condition about the liquid crystal equipment of drawing 4 .
[Drawing 8] It is the sectional view showing the cross-section structure of 1 operation gestalt of further others of the liquid crystal equipment concerning this invention.
[Drawing 9] It is the sectional view showing typically the display condition about the liquid crystal equipment of drawing 8 .
[Drawing 10] It is the perspective view showing the Personal Digital Assistant machine which is 1 operation gestalt of the electronic equipment concerning this invention.
[Drawing 11] It is the perspective view showing the condition of having opened the case of the Personal Digital Assistant machine of drawing 10 .
[Description of Notations]
1A, 1B, 1C Liquid crystal panel
2 Sealant
3a Common substrate
3b Segment substrate
4 Spacer
5 Lighting System
6 Liquid Crystal
7a, 7b Ingredient substrate
8a Common electrode
8b Segment electrode
9a, 9b Orientation film
11a, 11b Polarizing plate
12a The 1st reflecting layer
12b The 2nd reflecting layer
13 Light Guide Section Material
13a Light-scattering part
14 Light Source
16 Light Reflex Layer

17 Light Reflex Layer
21a, 21b Reflective polarizer
22a, 22b Polarizing plate
23a, 23b Inside electrode
E Transparency shaft
F Extinction shaft
G Cel gap

[Translation done.]

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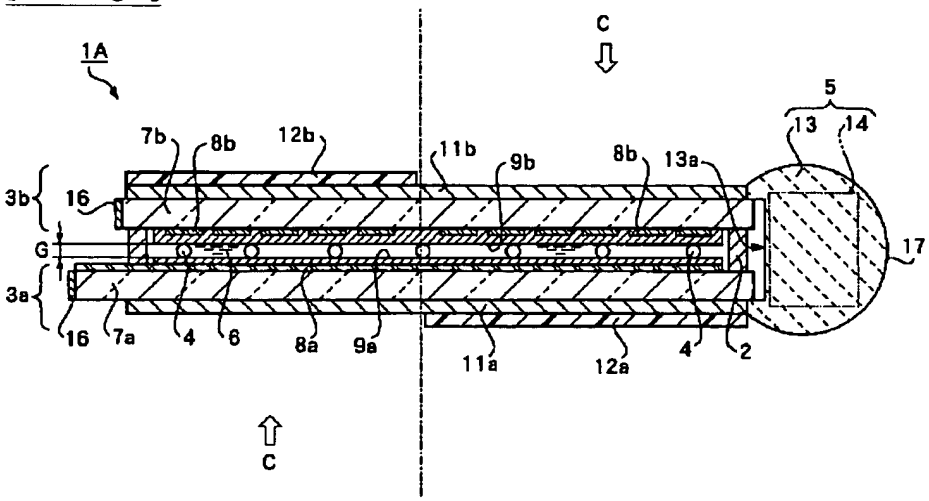
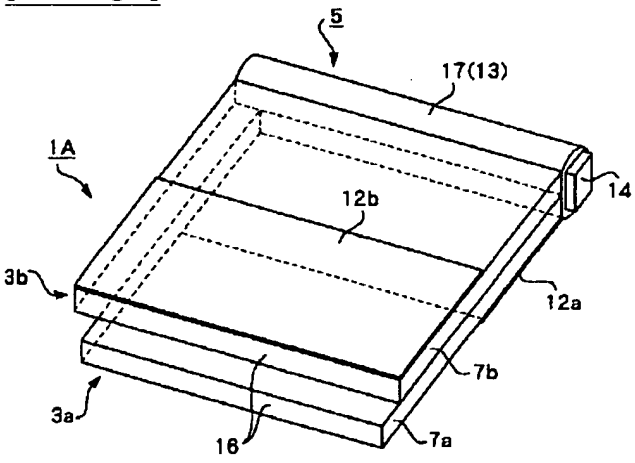
DRAWINGS

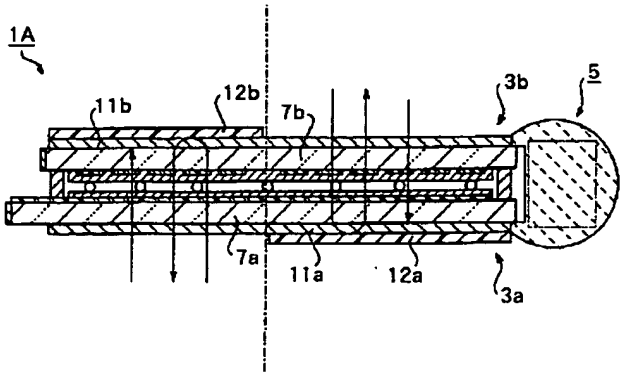
[Drawing 1]



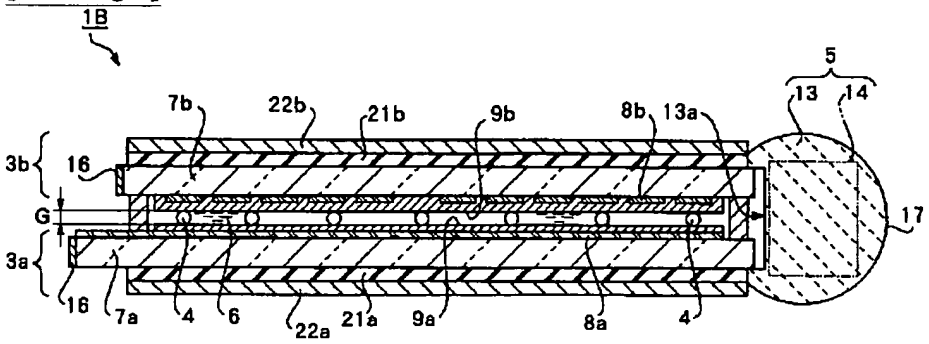
[Drawing 2]



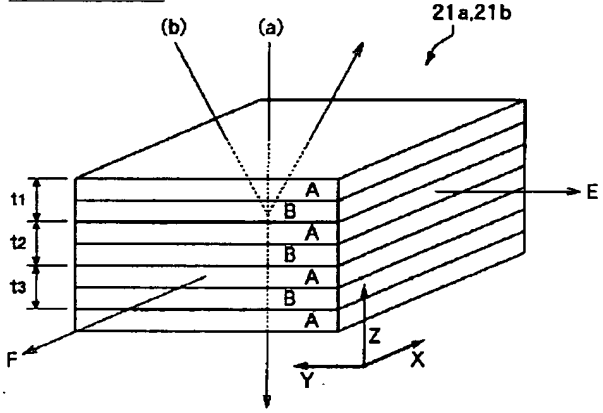
[Drawing 3]



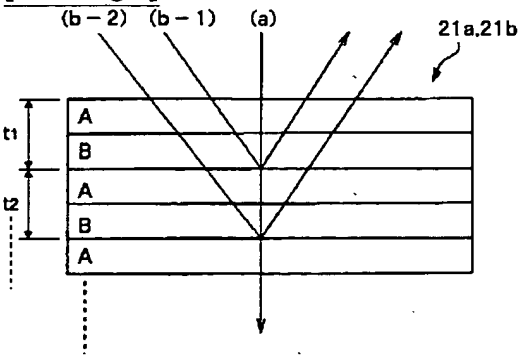
[Drawing 4]



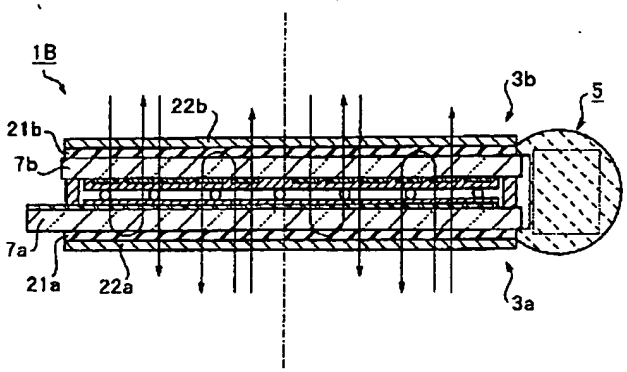
[Drawing 5]



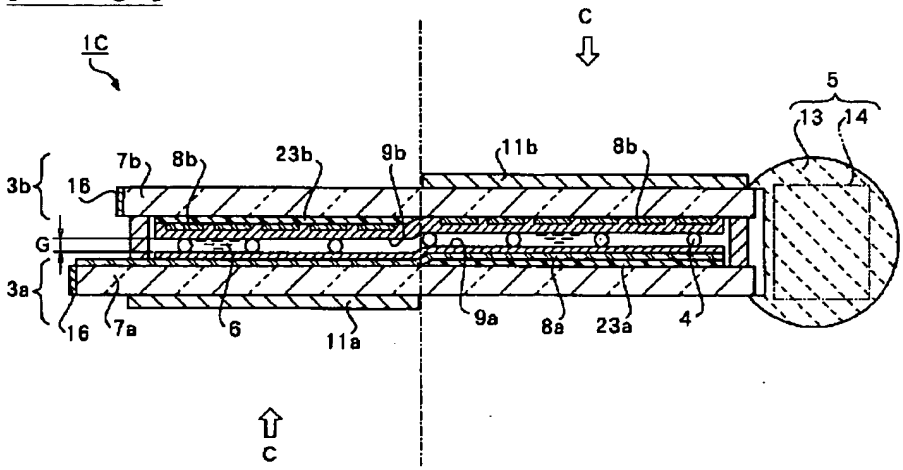
[Drawing 6]



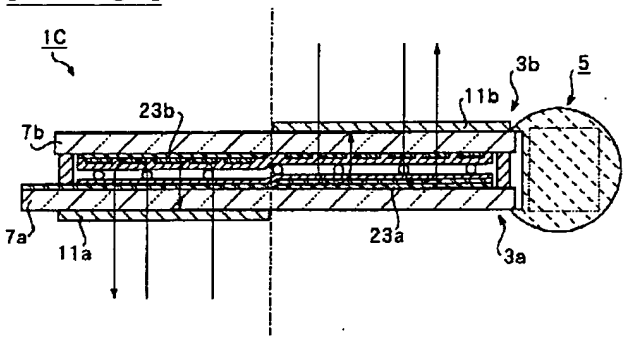
[Drawing 7]



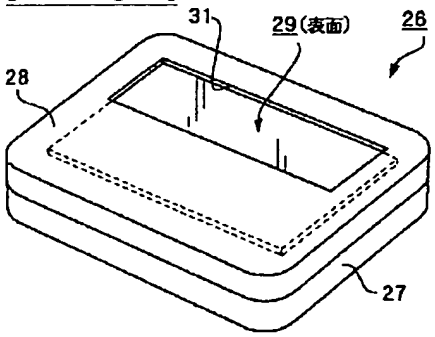
[Drawing 8]



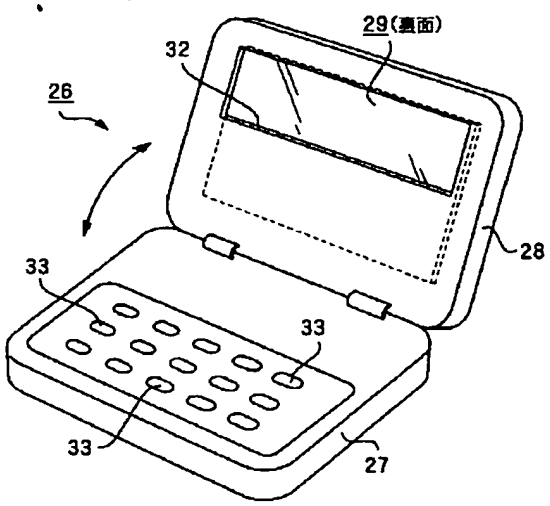
[Drawing 9]



[Drawing 10]



[Drawing 11]



[Translation done.]